

REMARKS

No new matter is believed to be added to the application by this Amendment.

Status of the Claims

Claims 2 and 13-24 are pending in the application. The amendments to claim 24 improve the language of this claim.

Objection to the Specification

The Examiner objects to the title as not being descriptive. A new title is provided that is descriptive of the subject matter being claimed.

Rejection Under 35 U.S.C. 112, Second Paragraph

Claim 24 is rejected under 35 U.S.C. 112, second paragraph as being indefinite. Applicants traverse.

Claim 24, as amended, does not contain the term "interact" that the Examiner feels is indefinite. As a result, claim 24, as amended, is clear, definite and has full antecedent basis. Accordingly, this rejection is overcome and withdrawal thereof is respectfully requested.

**Rejections Under 35 U.S.C. 103(a) Over Mitani in View of Wristers (and Gardner)**

Claims 2, 14, 15, 17, 23 and 24 remain rejected under 35 U.S.C. 103(a) as being obvious over Mitani (U.S. Patent No. 6,191,463) in view of Wristers (U.S. Patent No. 5,674,788). The Examiner adds the teachings of Gardner (U.S. Patent No. 5,581,888) to reject claims 18 and 20. Applicants traverse.

**The Present Invention and Its Advantages**

The present invention pertains to a gate insulator interpositioned between a semiconductor substrate and the gate electrode. The gate insulator is a silicon dioxide material containing both nitrogen and halogen, e.g., fluorine atoms. The nitrogen atom concentration in the gate insulator is more than  $1 \times 10^{20} \text{ cm}^{-3}$ . The insulated gate transistor of the invention can have a floating gate electrode and control gate electrode provided on the floating gate electrode with the interlayer insulator interposed between them.

In the invention, the interaction of the greater than  $1 \times 10^{20} \text{ cm}^{-3}$  nitrogen atom concentration and the fluorine is such that the flat band voltage is stable even if fluorine injection occurs. This can be readily discerned by the flat band voltage shown in Figure 2. This unexpected result is also discussed at page 13, lines 7-16 of the specification which states: "As shown in the

Figure, with a nitrogen atom concentration of  $1 \times 10^{20}/\text{cm}^3$  or more, a characteristic that the flat band voltage less changes even if fluorine is injected is obtained, from which it can be understood that boron contained in the gate electrode in the P-type transistor scarcely diffuses up to the channel region of the transistor. As shown in Fig. 2, in particular, with the nitrogen atom concentration equal to or more than  $1 \times 10^{20} (/ \text{cm}^3)$ , an abrupt improvement in the characteristic can be seen."

Further, the interaction of nitrogen and fluorine reduces the deterioration of transconductance. This effect is readily observed in Figure 7. Further, this effect is discussed at page 14, lines 20-25 of the specification which states "Whereas using nitrided oxide having a nitrogen concentration of  $1 \times 10^{20}/\text{cm}^3$  as the gate insulator would cause the deterioration of transconductance to increase, the addition of fluorine to the nitrided oxide having a nitrogen concentration of  $1 \times 10^{20}/\text{cm}^3$  reduced the deterioration of transconductance."

#### **Distinctions of the Invention Over Mitani, Wristers and Gardner**

Distinctions of the invention over Mitani, Wristers and Gardner have been previously placed before the Examiner. Neither Mitani nor Wristers disclose or suggest the interaction of the greater than  $1 \times 10^{20} \text{ cm}^{-3}$  nitrogen atom concentration and the fluorine such that the flat band voltage is stable even if fluorine

injection occurs, such as is set forth in independent claim 2. However, the Examiner fails to be convinced by the failures of the prior art of Mitani and Wristers.

In paragraph 9 of the Office Action, the Examiner asserts that although Mitani does not disclose the exact nitrogen atom concentration of the invention, it would be obvious to use this concentration to attain the advantage of preventing boron penetration into the gate insulator. By this, the Examiner is asserting that a nitrogen atom concentration of more than  $1 \times 10^{20} \text{ cm}^{-3}$  is somehow inherent in Mitani.

However, the Federal Circuit stated in In re Robertson, that "to establish inherency, extrinsic evidence must make clear that the missing descriptive matter was necessarily present in the thing described in the reference, and would be so recognized by persons with ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a set of circumstances is not sufficient." In re Robertson, 49 USPQ2d 1949 (Fed. Cir. 1999). Further, it has been held that the mere fact that a certain thing may result from a given set of circumstances is not sufficient, and occasional results are not inherent. MEHL/Biophile International v. Milgraum, 52 USPQ2d 1303 (Fed. Cir. 1999).

As a result, a person having ordinary skill in the art would not be motivated by the teachings of Mitani and Wristers to produce

a claimed embodiment of the invention where the nitrogen atom concentration of the gate insulator is more than  $1 \times 10^{20} \text{ cm}^{-3}$ , and the flat band voltage is stable even if fluorine injection occurs (See claim 2). Thus, a *prima facie* case of obviousness has not been made over Mitani and Wristers. The addition of the teachings of Gardner fails to address the deficiencies of Mitani and Wristers, and thus a *prima facie* case of obviousness has not been made over the three-fold rejection over Mitani, Wristers and Gardner.

Further, even if it is assumed *arguendo* that the combination of Mitani and Wristers or the combination of Mitani, Wristers and Gardner is sufficient to assert *prima facie* obviousness, this obviousness would be rebutted by unexpected results. These unexpected results are clearly shown in Figure 2, where a stable flat band voltage has occurred when nitrogen is present at  $10^{20} \text{ cm}^{-3}$ . The improvement of the invention on transconductance is clearly shown in Figure 7 of the application. These unexpected results are further discussed in detail at pages 13 and 14 of the specification. Thus, the advantages of the invention are clear.

As has been shown, the applied art is insufficient to assert *prima facie* obviousness. Even if obviousness could be alleged, this obviousness would be fully rebutted by unexpected results. Accordingly, these rejections are overcome and withdrawal thereof are respectfully requested.

**Conclusion**

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert E. Goozner, Ph.D. (Reg. No. 42,593) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

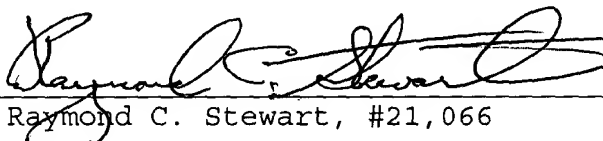
Attached hereto is a marked-up version of the changes made to the application by this Amendment.

Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), Applicant(s) respectfully petition(s) for a two (2) month extension of time for filing a reply in connection with the present application, and the required fee of \$410.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By   
Raymond C. Stewart, #21,066

Ⓢ  
RCS/REG:jls  
0020-4652P

P.O. Box 747  
Falls Church, VA 22040-0747  
(703) 205-8000

Attachment: Version with Markings to Show Changes Made

(Rev. 02/20/02)

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE TITLE:

The title has been amended to read: "INSULATED GATE TRANSISTOR  
HAVING A GATE INSULATOR CONTAINING NITROGEN ATOMS AND FLUORINE  
ATOMS".

IN THE CLAIMS:

The claims have been amended as follows:

24. (Amended) The insulated gate transistor according to claim  
2, wherein the nitrogen and the fluorine [interact to] reduce  
deterioration of transconductance.